heard the song of the Hermit Thrush. Although I had spent my life in the winter home of this bird and its habits were as familiar to me as those of the Mockingbird, I had never heard it utter a sound other than a low, guttural, monosyllabic note expressive of alarm and kindred emotions. I was thus unprepared for the marvelous and elaborate song I heard on that 19th day of March, 1905. It marks an epoch in my ornithological career. Referring to my journal of that date I find the following: "I was out in Lively's woods early Sunday morning, March 19, 1905. Recent rains had dampened the woods so that a gloomy aspect pervaded the whole scene. I was standing down the ravine when off in the distance, apparently over in the pasture, I heard the faint notes of what I was sure must be the Wood Thrush; its song being familiar to me in consequence of my late temporary residence in the District of Columbia. I hastened in the direction of the sounds and as I drew near the edge of the woods descried a bird sitting in a small wild plum tree. It seemed annoyed at my intrusion. I stopped to look at it and finding only a Hermit Thrush started on in quest of the singer, when to my surprise the bird settled down upon its perch and commenced in low notes the sweetest and purest song I have ever heard. A lovelier melody never fell upon more grateful ears. The notes, liquescent and ventriloquial, beginning afar off, approaching slowly and finally bursting upon me, are impossible to be described." Mr. Brewster tells me that he has heard them singing in the swamps of Jackson County in early spring.

VARIATION IN THE HAIRY WOODPECKER (*DRYOBATES VILLOSUS* AND SUBSPECIES).

BY HUBERT O. JENKINS.

THIS study was originally intended to be limited to the western forms of the Hairy Woodpecker but later it seemed desirable to include data that had accumulated concerning all of the forms.

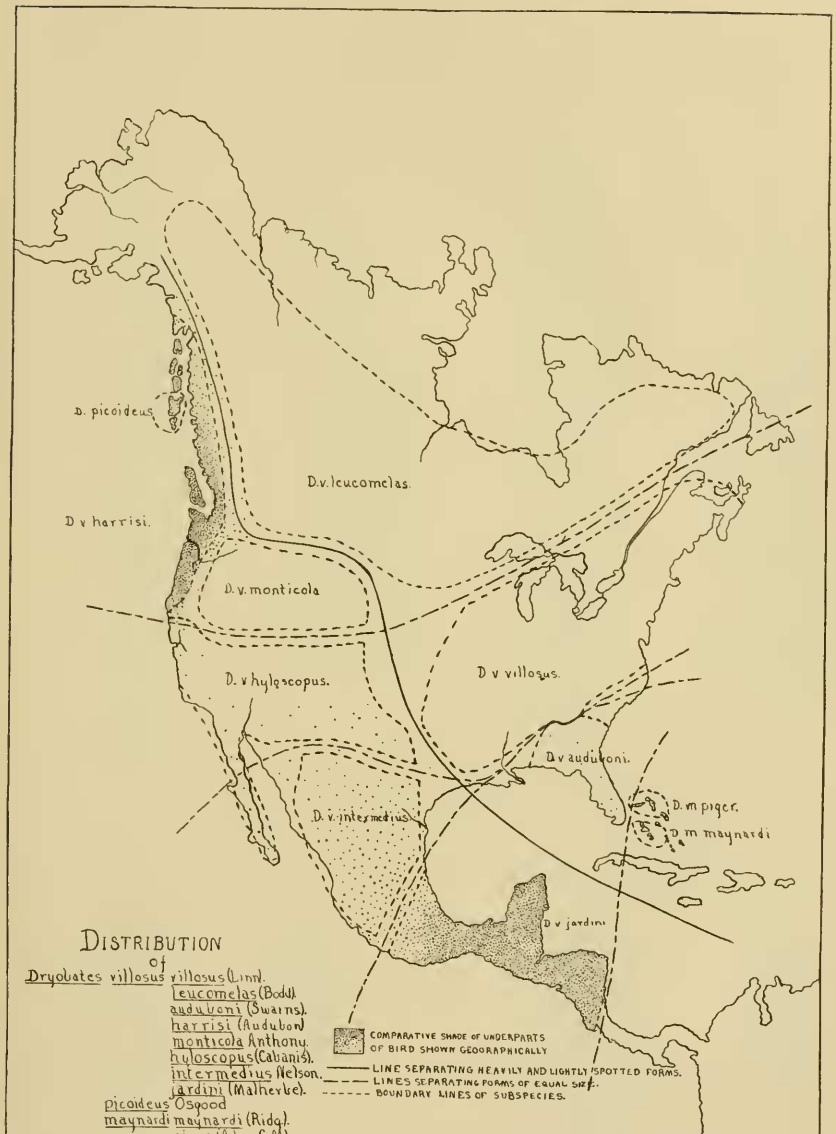
The number of adult specimens of each form examined was as follows: *D. v. harrisi*, 43; *D. v. hyloscopus*, 104; *D. v. monticola*, 7; *D. v. leucomelas*, 9; *D. v. villosus*, 12, and *D. v. auduboni*, 3. This includes a large number of intermediates and does not include some 30 immature birds.

I wish to thank Mr. Joseph Grinnell, Mr. W. K. Fisher, Prof.

J. O. Snyder, and Prof. O. P. Jenkins for numerous suggestions and assistance. For the privilege of examining specimens I am greatly indebted to the United States National Museum, the California Academy of Sciences, Mr. Joseph Grinnell, and Mr. W. Otto Emerson.

The Hairy Woodpecker is a form widely distributed over the continent of North America, ranging from Alaska and Hudson Bay to Central America and from the Atlantic to the Pacific Oceans. The bird varies somewhat in localities distant from each other so that different groups have been given different subspecific names, but from their close similarity and habits all are regarded by some authors as belonging to the same species. Its nearest relative is evidently the Downy Woodpecker, which is much smaller, although the only difference in plumage of the Downy Woodpecker is the barring of the outer tail feathers, which are pure white in the Hairy Woodpecker. In the West, although inhabiting the same general localities, the two species are not often found immediately together. In the East, however, this separation does not hold. The food question no doubt is as vital a question with them as with any other animals and on this account the birds have come to occupy the particular regions best supplying their wants. In the West the Downy Woodpecker frequents the willows and creek beds, orchards and valley districts, where it is constantly on the lookout for grubs and larvæ, digging them out of bark or spearing them with its long pointed tongue, while the Hairy Woodpecker, a stronger, hardier bird, occupies the mountainous districts and seems especially to love the pine forests. Many specimens indicate this by the telltale pitch left on their breasts. In the depth of winter it is found away up in the Boreal Zone of the Sierras, making the chips fly in search of its favorite food, undisturbed by the rigorous cold. However, it is not an abundant bird and is very shy of man. When you approach, it sidles around on the other side of the limb and watches you with one eye and if it suspects injury in the least, is gone in a moment, swinging high over the tree tops uttering its shrill, quick *peek, peek.*

As mentioned before, the Hairy Woodpecker differs more or less in different regions, and has consequently been split up into several subspecies or varieties by systematists, who recognized the differ-



DISTRIBUTION OF *Dryobates villosus* AND SUBSPECIES.

ences as soon as material began to accumulate. Linnæus[1] in his 'Systema Naturæ' of 1766 first formally named the species. He gave it the specific name of *villosus* and placed it in the genus *Picus*. This genus was later restricted to certain European Woodpeckers and the genus *Dryobates* was proposed to include the American form, so that our Hairy Woodpecker has become *Dryobates villosus*. In 1783 Boddaert[2] discovered that the birds in Canada which resembled *villosus* in markings were considerably larger, and since this difference was constant he separated the Canadian form under the name *Picus leucomelas*. Some fifty years later Swainson,[3] in examining a number of specimens of the Hairy Woodpecker from different parts of North America, came to the conclusion that those inhabiting the southern United States should have a separate name and he called them *Picus audubonii*. He had but one specimen, from Georgia, and took the risk that others from that locality would conform to his type, and he proved not to have been mistaken in his conclusions. Audubon[4] discovered a new species on the Columbia River in 1839, Malherbe[5] another in southern Mexico in 1845, and Cabanis[6] in 1863 separated the southern California bird from Audubon's *harrisi* and called it *Dryobates hyloscopus*. Audubon's bird was a very dark-breasted form, distinct from anything yet known, while Cabanis's bird was a light-breasted form, more like the eastern *villosus*, but yet with certain characters (to be mentioned later) separating it from *villosus*. In rather recent years, as more specimens were acquired, the Cabanis form was found to include more than one race. Anthony[7] described a larger bird from the Rocky Mountains and Nelson[8] found differences in specimens from the arid tablelands of northern Mexico.

When we get together material from all over North America we find that all the Hairy Woodpeckers belong to one species, and

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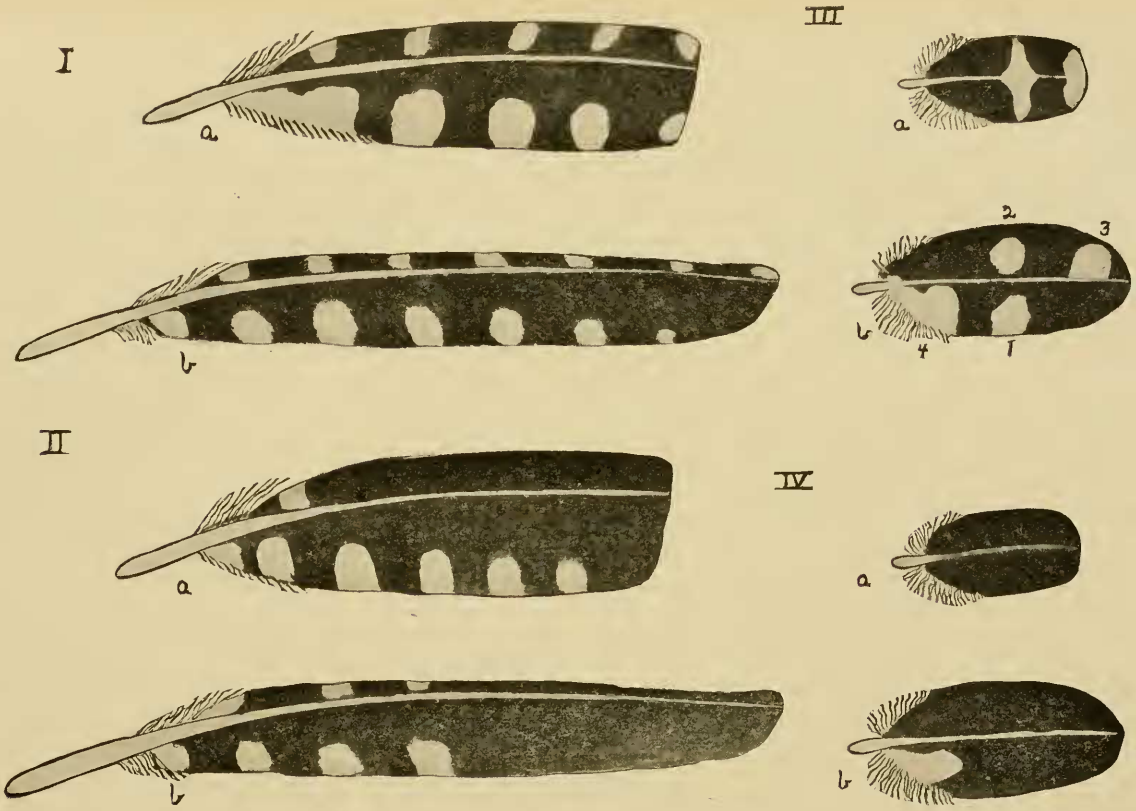
[1] Linn., S. N., ed. 12, I, 1766, p. 175.
[2] Boddaert, Tabl. Pl. Enl., 1783, p. 21.
[3] Swains. in Sw. & Rich., Fauna Bor. Am., II, 1831, p. 306.
[4] Aud., Orn. Biog., V, 1839, p. 191.
[5] Malherbe, Rev. Zool., 1845, p. 374.
[6] Cab. & Heine, Mus. Hein., IV, ii, 1863, p. 69.
[7] Anthony, Auk, XV, Jan., 1898, p. 54; *ibid.*, XIII, Jan., 1896, p. 32.
[8] Nelson, Auk, XVII, 1900, p. 259.



COMPARISON OF THE WING-SPOTTING OF THE EASTERN AND WESTERN FORMS OF *Dryobates villosus*.

I, Eastern Forms; II, Western Forms.
a Secondary, *b* primary.

III, Eastern Forms; IV, Western Forms.
a Median covert, *b* greater covert.

Boddaert's *leucomelas* and Malherbe's *jardini* are subspecies connected by links still existing for the whole length of North America.

In *Dryobates villosus leucomelas* the under parts are entirely pure white. The upper parts are black except for a white stripe down the back. The crown and sides of the head are black. There is a white stripe over and behind the eye, and another running from the nasal tufts around under the eye to spread on the side of the neck. In the male there is a scarlet nuchal band which is wanting in the female. The young of both sexes has the whole crown partly red or yellowish. The outer feathers of the tail are white and the inner black. The wings are marked profusely with white spots.

Analyzing the wing we find that the primaries have four to seven large round spots on either web which are placed equally distant apart. The proximal four spots are always present and each of the three distal ones, although generally present in all primaries except the first, is less persistent than its respective proximal neighbor. Thus the seventh or most distal spot is often absent, especially in the shorter primaries.

The secondaries have five spots on the outer web, which are round and as large as the width of the web permits. The inner web has six spots, which are quite large, and the two proximal ones are confluent.

The greater coverts have four spots, as shown in the figure, and the lesser coverts are crossed by two bars. Rarely, spot No. 1 is omitted from the greater covert and in the lesser covert there is a slight variation tending to shorten the long axis of the proximal bar.

The range of this form is northern North America from the interior of Alaska (Ft. Reliance) to Labrador and south to about the northern border of the United States. It does not include the Pacific Coast region.

Dryobates villosus villosus is much the same as *D. v. leucomelas* in coloration and markings but is a decidedly smaller bird. The primaries and secondaries have on the average the same spotting pattern, but the three-spotted greater covert predominates over the four-spotted form, and many of the median coverts have, instead of two bars, two rounded or irregularly shaped spots which are rarely coalesced to form a central streak.

Its distribution is the United States east of the Rocky Mountains and north of about 35° N. Lat.

Dryobates villosus audubonì of the southern United States is a small dark bird. The wing spotting is very little different from that of the other two forms just mentioned. The spots on the primaries and secondaries average very slightly less in number. Of course they are smaller in size than in *leucomelas*, but compared with the size of the feather they are relatively the same. The greater coverts have lost spots 1 and 2 but 3 and 4 are always present. The median coverts have a single spot which is variable in size and shape.

Compared with *leucomelas*, *audubonì* is extremely different. Compared with *villosus* the difference is not so great. Between the extremes of these subspecies there are intermediates in size. So that if we proceed from north to south we find a gradual and certain decrease in size. One writer[1] records a distinct line between *audubonì* and *villosus* in the southern Alleganies. He says that he found *villosus* occupying the Balsam regions above 4000 feet, and *audubonì* in the lowlands up to 4000 feet, and that all birds are easily distinguished. Very likely intergradation does not take place at that point. However, it certainly does at other localities.

Proceeding from east to west we find the birds gradually losing the white wing spots, and when we reach the Pacific Coast the closed wing shows but little white.

In the southwestern United States we have *Dryobates villosus hyloscopus*. It is more nearly the size of *D. v. villosus*. The under parts of some examples of *hyloscopus*, on close examination, show a slight tinge of brownish red, but the distinguishing character is found in the spotting of the wing. The outer web of the primary has but three spots. These correspond with the three proximal spots of the eastern form, but are much reduced in size. The inner web has retained the four proximal spots, which are also reduced in size. The secondary has lost all but the most proximal spot from the outer web. The inner web has the same number of spots as that of the eastern bird, but the spots are smaller and the two proximal ones are not confluent. The greater coverts have only spot No. 4 left. The median coverts are either entirely black or have a white streak down the center. This form is

[1] Brewster, Auk, III, p. 104.

found in California, Lower California, Arizona, and New Mexico. Some of the specimens at hand from New Mexico are intermediate in spotting between the western and eastern forms but are nearer the western.

Dryobates villosus harrisi has the wing spotting like *hyloscopus* but the light parts are a deep smoky brown. The extreme of this form is found at Vancouver Island and along the coast region of British Columbia and Washington. There, all birds are uniform smoky and the wings have a uniform scarcity of spots. In northern California and southern Oregon, *harrisi* and *hyloscopus* intergrade. In the Siskiyou Mountains are found birds that vary from pure white to very dark. At Sitka, Alaska, *harrisi* has become very much lighter and some specimens show a great increase in wing spotting. Three specimens from Ducks, B. C. (a region between the Rocky and Cascade Mountains), have characters of both *leucomelas* and *harrisi*. The under parts are pure white while the wings are scarcely spotted. A fourth specimen from the same locality is profusely spotted and hence nearer *leucomelas*.

Dryobates villosus monticola, found in the Rocky Mountains from Colorado to Montana, has a scarcity of wing spots like the other western forms but is larger than *hyloscopus* and the under parts are said to be pure white without any reddish tinge as with some *hyloscopus*. (In the series at hand there are few specimens of this form, but I believe that when more material has accumulated, the range of *D. v. monticola* will be found to extend no farther south than Colorado or farther north than southern Montana and will include Utah, northern Nevada, eastern Oregon, southeastern Washington and southern Idaho. The evidence for the southern boundary is the fact that *D. v. hyloscopus* reaches its maximum size in the northern Sierra Nevadas while specimens from Arizona and New Mexico are comparatively quite small. The northern boundary is indicated by intermediates between *D. v. leucomelas* and *D. v. monticola* taken in Montana. And if any form is to be found in the arid interior of Washington and Oregon it would not likely be *D. v. harrisi*, since that form is not found outside of the Humid Coast Belt in Alaska.)

Dryobates villosus jardini is smaller than *hyloscopus*, the under parts are very dark, and it inhabits the mountainous portions of Central America and Southern Mexico.

Dryobates villosus intermedius, ranging in the territory between *hyloscopus* and *jardini*, is smaller than *hyloscopus*, larger than *jardini*, and is also intermediate in smokiness of the underparts.

Besides the eight subspecies mentioned, there are two island forms that are not known to intergrade with the continental species.

Dryobates picoideus[1] inhabits the Queen Charlotte islands off British Columbia. It has the white stripe on the back barred or spotted, and is entirely distinct from any other form.

Dryobates maynardi includes two subspecies, *D. m. maynardi*[2] of the southern and *D. m. piger*[3] of the northern Bahama Islands. In 'The Auk,' XXII, April, 1905, pp. 124–126, Mr. Allen has shown that *piger* and *maynardi* intergrade, but it seems that neither one intergrades with the mainland *auduboni*. (The name *Dryobates maynardi piger* (Allen) is more nearly correct than *Dryobates villosus piger* Allen, if we would fulfil the requirements of "the test of intergradation for subspecies." However, having recognized the subspecies, it is to be admitted that the combination is really of minor importance.)

Viewing the Hairy Woodpeckers as a whole we see that there are certain variations in the structure of the birds corresponding to certain regions. Why these variations exist we cannot say with certainty. It is probably through natural selection and the survival of those best fitted to escape from enemies or to obtain food in the particular region that they inhabit, but why a profusely spotted bird can get along better in certain localities than in others, and a large bird can get along better in the north than in the south is hard to say.

Taking up the lines of variation separately we have first, the Spotting: —

It is plain that the spots on the inner webs and proximal ends of the feathers are more persistent. So we might reason that the western bird is more highly developed, as follows: that the spots so common among the Woodpeckers were originally developed for some good service, as for directive markings, etc.; but to make the bird less conspicuous while climbing up dark colored tree trunks, the white on the outside of the closed wing was greatly reduced.

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[1] Osgood, N. Am. Fauna No. 21, 1901, p. 44.

[2] Ridgway, Manual N. Am. Bds., p. 282 (1887; see Cory, Auk, 1886, p. 375).

[3] Allen, Auk, XXII, 1905, p. 124.

Thus not only would the bird more nearly resemble the background, but the attractive feature of large white spots on black feathers would be done away with. To reduce the white on the closed wing it was only necessary to eliminate the spots from the exposed portions of the feathers, namely the outer webs and the ends of the flight feathers and coverts, for the inner web of each flight feather is covered by the outer web of the preceding feather and only the distal ends of the coverts are exposed. This is just what we have in the Western Hairy Woodpecker wing. The spots on the outer webs of the secondaries are reduced to a single one at the base of each feather, which is always hidden by the greater coverts. The spots on the exposed parts of the greater coverts are reduced in number and size, or more commonly are entirely absent, and the spots on the median coverts are either absent or reduced to a mere streak. Several spots on the outer webs of the primaries still persist but they are fewer in number and are much reduced in size and are consequently very inconspicuous.

When the bird is in flight it does not need this protective coloration but probably does need the spots for the same purposes for which they were originally developed, and we find that nearly all of the spots on the parts of the wing that were unexposed when it was closed, namely those on the inner webs of the flight feathers, are still retained. The inner web of the secondary has lost only the outermost spot, and the inner web of the primary the three outer spots, but these were the smallest spots in the eastern bird and of the least importance. When the bird flies, the wing is thrown up as often as down, and the striking contrast of white and black is about, though not entirely, as effective as before to all observers except those that may be directly overhead.

Thus we have the least possible contrasting shades on the bird at rest combined with the greatest possible contrasts on the bird in flight, and given that the contrast in flight is of use to the bird, then this combination is an advantage and was developed as such.

Could this theory be absolutely proven we would still have to explain why all of the Hairy Woodpeckers have not developed in like manner. If we draw a geographical line between light and heavily spotted forms this line would in part coincide with the geographical line between the Arid West and Humid East. But I

greatly doubt if aridity and humidity has anything to do with the wing spotting. We might say that the more highly developed form has had more enemies and more competition, but such a statement needs yet to be proven.

As for the darkening of some colors of birds, it has been said that it is an advantage in any humid region where there is a great deal of shade. So we find the range of the darkest woodpecker (*D. v. harrisi*) exactly coinciding with that region of North America which has the greatest total shade, namely the Pacific Humid Coast Belt. *D. v. jardini* is said to inhabit an extremely humid region in southern Mexico, but scarcity of data from that region prevents forming definite conclusions in regard to it.

If we draw geographical lines separating forms of equal size, these lines will nearly coincide with parallels of latitude. Very likely either the more rigorous climate of the north has eliminated all birds except the larger and hardier, or else there is a direct physical effect on the individual causing it to grow larger.

It is a strange fact that the Downy Woodpeckers vary exactly as the Hairy in size, wing spotting and coloration, and for every continental form of the Hairy Woodpecker north of Mexico there is a corresponding form of the Downy. In Mexico the latter is not found.

AVERAGES OF MEASUREMENTS (IN MILLIMETERS) OF THE FORMS OF *Dryobates villosus*, TAKEN ONLY FROM SPECIMENS EXAMINED BY THE AUTHOR.

Form	No. of Specimens	Sex	Tarsus	Toe	Claw	Tail	Wing	Bill
D. v. leucomelas	5	♂	24	18.5	10.5	82	129	33
" " "	4	♀	25	18	10.5	79	128	33
D. v. villosus	6	♂	22.5	18	10.5	79.5	125	33
" " "	6	♀	21	17	10	76	121	29
D. v. audubani	2	♂	21.5	17.5	10	64.5	113	29.5
" " "	1	♀	20.5	16	10	68	115	29
D. v. harrisi	23	♂	23.5	18	10.5	79	128	32
" " "	20	♀	23	18	10	80	124	31.5
D. v. hyloscopus[1]	43	♂	23	17.5	10	78	126.5	33.5
" " "	14	♀	22	17	10	77	123.5	30
D. v. hyloscopus[2]	30	♂	22	16.5	10	75	124	32
" " "	17	♀	21.5	16	9.5	75	122	28
D. v. monticola	5	♂	23.5	17.5	10.5	83.5	132.5	34.5
" " "	2	♀	21.5	16	10	85	130	—

[1] California north of 35° N. Lat.
[2] Except California north of 35° N. Lat.